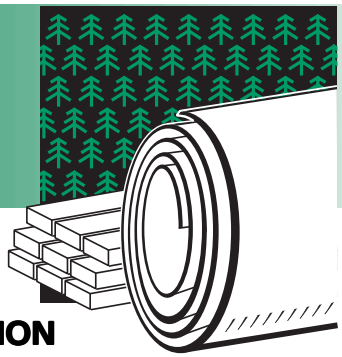
FOREST PRODUCTS

Project Fact Sheet



Electrochemical and Integrated Process Opportunities for On-Site/On-Demand Generation of Chlorine Dioxide at Reduced Costs

Benefits

- Estimated savings of $60/ton of chlorate in energy costs (equivalent to 0.4 V of savings for a 3.0 V cell), or $30 million annually, to produce 500,000 tons of chlorate for the U.S. market
- Fewer environmental emissions because of reduced demand for electricity and ready displacement of chlorine in bleaching operations
- Additional savings in product concentration, separation, transportation, and overhead costs for mills using the chlorate technology on-site
- Potential for cathode to operate over a long lifetime
- Use of resources of the Microfibrous Materials Manufacturing Initiative at Auburn University

Applications

The forest products industry has identified chlorine dioxide as a viable alternative to molecular chlorine for pulp bleaching. Mills are expected to readily adapt a technology that produces the chlorate precursor on site and on demand. These electrochemical techniques would be integrated with the mill's processes for lower energy and life-cycle costs.

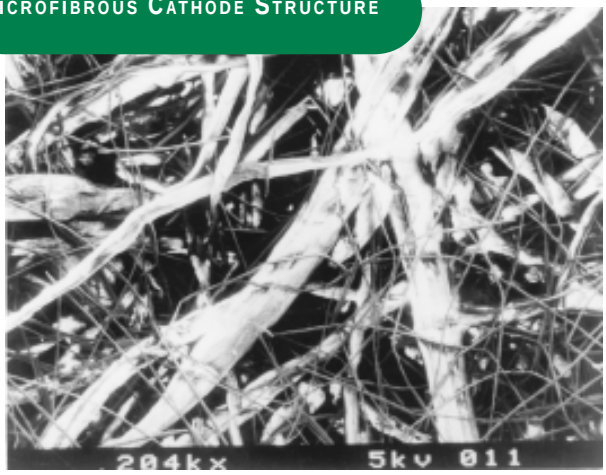
New electrode technologies will be superior to conventional chlorate production systems

There are environmental constraints against the use of molecular chlorine in bleaching operations in the pulp and paper industry, and the industry is turning to chlorine dioxide (ClO_2) as an alternative bleaching agent. The most efficient method for producing ClO_2 involves purchasing sodium chlorate ($NaClO_3$) and reducing it to chlorine dioxide through a reaction with hydrochloric acid or sulfur dioxide. It is important to the industry that the cost of $NaClO_3$ is kept low to make this process cost-effective. Unfortunately, the increased demand for chlorine dioxide as a bleaching agent has raised the price of its precursor, and the industry must look for other options to produce chlorine dioxide.

Electrochemical methods for generating chlorine dioxide directly are expensive or the processes have other penalties. New electrode technologies are needed to overcome present limitations to on-site/on-demand production of ClO_2. Investigators at Auburn University believe that a unique three-dimensional structure they have developed for the primary cathode will provide U.S. mills with an efficient and cost-effective method for producing ClO_2. The cathode is an intermingled network of metal fibers and of activated carbon fibers to which appropriate combinations of catalytic metals have been added. The cathode technology is revolutionary in that it is made on high-speed, paper-making equipment, and forms a strong, conductive structure.

Additional work is underway to develop and demonstrate this microfibrous composite electrode and/or other three-dimensional structures useful to the manufacture of low-cost, high-performance commercial cathodes.

Microfibrous Cathode Structure



Scanning electron micrograph showing typical microfibrous metal-cellulose electrode structure prior to sintering (heat treatment) in furnace. Structures are typically very high in void volume, usually in excess of 80%, allowing impregnation with catalyst metals.

Project Description

Goal: Development of chlorate cathodes using low-cost materials and manufacturing processes, with a potential life of two years and a payback of four months.

A program is underway to further develop three-dimensional electrodes for chlorate production that will be technically and economically feasible for use by commercial mills. A strategic partner is also developing cathodes to reduce molecular oxygen to hydrogen peroxide as a bleaching agent. The cathode structure will be optimized and its performance characterized, life testing will be carried out, and life-cycle costs will be estimated. Commercial 3-D carbon cathodes will be impregnated with catalyst metals to serve as benchmarks. The opportunity to integrate the design and microstructure of the commercial cathode with the process control will also be explored.

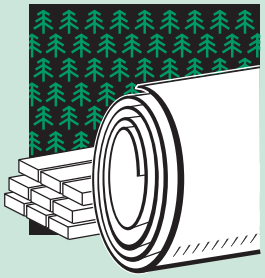
Progress & Milestones

- Laboratory testing and modeling of electrode structures are completed.
- Evaluation of corrosion and potential lifetimes of 3-D collector structures have been made to choose a preferred structure.
- Electrocatalyst metals have been impregnated and optimized in chlorate half cells.
- A bench-scale chlorate electrolyzer is being built for industrial testing of electrode lifetime and performance.
- Technical and economic analyses are underway on a bench-scale level to ensure the success of the technology on an industrial scale.
- An in-plant demonstration will occur during the final year of the project.

Awards, Patents, and Invention Records

U.S. Patents Received:

- 5,080,963 January 14, 1992
- 5,096,663 March 17, 1992
- 5,102,745 April 7, 1992
- 5,304,330 April 19, 1994
- Foreign/EPO



Project Partners

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Chemetics International

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